Chemistry 129.01 - General Chemistry Workshop - Spring 2017

Week #7

Wednesday, March 8. Oxidation Numbers and Redox Reactions; Intermolecular Forces

Assigned reading: Sections 10.1, 10.2

We'll finish our discussion of oxidation numbers of atoms and how to use them to determine what substances are reduced or oxidized in Redox reactions.

This week we are also discussing some of the most important forces found in chemistry – the weakest ones. These are the forces that occur between molecules and are therefore called "intermolecular" forces. Intermolecular forces explain a ton of useful everyday chemistry as well as the details that chemists study: melting points, boiling points, viscosity, binding of substrates to enzymes to name just a few.

We start out by talking about several types of intermolecular interactions and how they operate. You need to learn some terms here. Try writing some definitions for each of the following type of force. Collectively they are sometimes called van der Waals forces.

Before Wednesday's class,

1. Define the following terms:

   Intermolecular Forces

   Viscosity

   Cohesive Forces

2. List the intermolecular forces described in the book.

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Friday, March 10. Phase Changes and Phase Diagrams

Assigned reading: Sections 10.3, 10.4

Quiz today: Molecular Orbital Theory, Session 6 calculations.

Today in class we will work on an activity to learn about some of the consequences of intermolecular forces interactions.

This will lead into our discussion of the phases of matter (solid, liquid, gas), how chemists describe them and phase changes. We'll also talk a little about phase diagrams.

Before Friday's class,

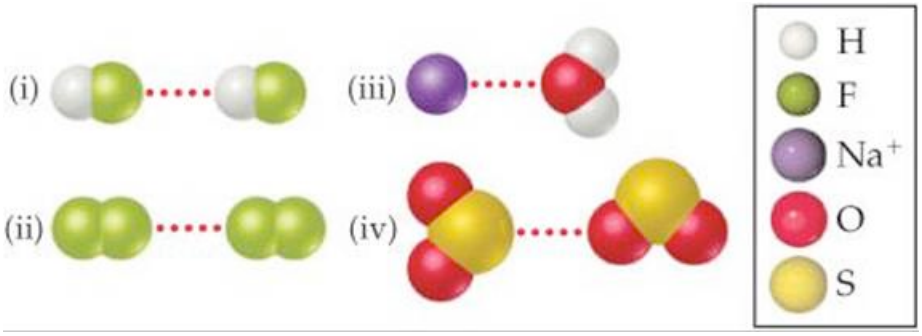
1. Define the following terms:

   deposition

   gas

   phase diagram

2. Take a look at the following figure. For each pair, identify the intermolecular force shown as a dotted line. Which two forces are generally the strongest ones?



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Problem Set #1

Due Monday, March 13 (at the beginning of class). Late homework will not be accepted.

1. Read article in session 10 and answer one of the questions 1-4 and question 5.

2. Determine the oxidation number of all the elements in the following compounds:
   (a) N_2H_4 (b) $SnCl_3^-$ (c) $C_2O_4^{2-}$ (d) HNO_2

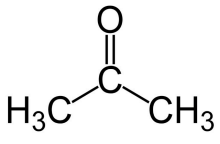
3. Determine the oxidation number of all the elements and determine which element is reduced and which is oxidized in the following reactions:

   (a) $3\ Fe(NO_3)_{2\ (aq)} + 2\ Al_{(s)} \rightarrow 3\ Fe_{(s)} + 2\ Al(NO_3)_{3\ (aq)}$

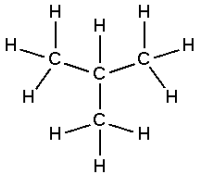
   (b) $Cl_{2\ (aq)} + 2\ NaI_{(aq)} \rightarrow I_{2\ (aq)} + 2\ NaCl_{\ (aq)}$

4. What type of intermolecular force accounts for the following differences in each case?

   a. CH_3OH boils at 65 °C, CH_3SH boils at 6 °C.
   b. Xe is liquid at atmospheric pressure and 120 K, whereas Ar is a gas.
   c. Kr, atomic weight 84, boils at 120.9 K, whereas Cl_2, molecular weight about 71, boils at 238 K.
   d. Acetone boils at 56 °C, whereas 2-methylpropane boils at -12 °C.



Acetone

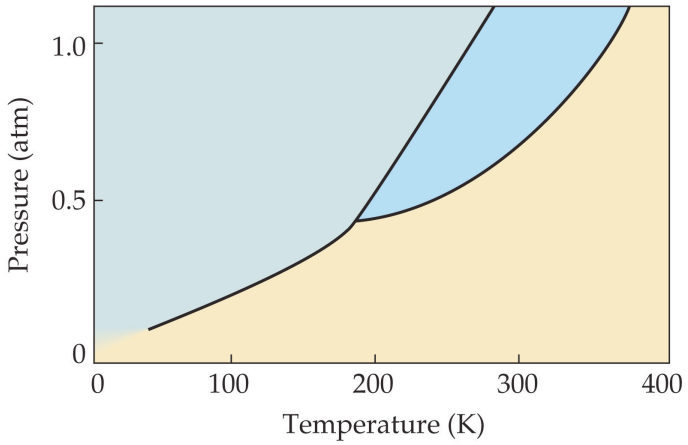


2-Methylpropane

5. Identify the types of intermolecular forces present in each of the following substances, and select the substances in a each pair that has the higher boiling point:
   a. C_6H_{14} or C_8H_{18} c. HOOH or HSSH
   b. C_3H_8 or CH_3OCH_3 d. NH_2NH_2 or CH_3CH_3

6. Name the phase transition in each of the following situations:
   a. Bromine vapor turns to bromine liquid as it is cooled.
   b. Crystals of iodine disappear from an evaporating dish as they stand in a fume hood.
   c. Rubbing alcohol in an open container slowly disappears.
   d. Molten lava from a volcano turns into solid rock.

7. The phase diagram of a hypothetical substance is shown in the following figure.



a. What is the physical state of the substance under the following conditions at T= 100K and P= 1.0 atm?

b. What is the physical state of the substance under the following conditions at *T* = 350 K and *P* = 0.5 atm ?

c. Estimate the triple point of the substance (Pressure and Temperature).